A mixed-integer nonlinear programming model for CO_2 emission reduction in the power generation sector

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Abstract: Economic and industrial developments are expected to be accompanied by an increase in the emissions of air pollutants. These pollutants often have detrimental effects, directly or indirectly, on human health and natural resources. Electricity generation is considered to be one of the main contributing sources to the air pollution problem. It is, therefore, important to develop and implement effective control strategies to prevent the expected abrupt increase in emissions from this sector. Any control strategy must be suitable for local implementation and must also be economically viable. The main objective of this paper is to present optimisation models that can be used to determine the most cost effective strategy or combination of strategies to reduce CO_2 emissions to a specific level. Optimisation results for an existing network of power plants show that it may be possible to reduce CO_2 emissions by increasing power plant efficiency through a variety of adjustments in the plants. These include fuel balancing, fuel switching, and the implementation of improvement technologies to existing power plants to increase their thermal efficiency.

Keywords: air pollution during electricity generation; carbon dioxide emission reduction; non-linear programming model; power plant efficiency.